

FOUR NEW SPECIES OF THE GENUS *NEMOURA* (PLECOPTERA: NEMOURIDAE) FROM CHINA¹

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ABSTRACT: Four new species of the genus *Nemoura* from China are described: *N. cocaviuscula* Du and Zhou, sp. nov., *N. lui* Du and Zhou, sp. nov., *N. magnispina* Du and Zhou, sp. nov., and *N. rotundprojecta* Du and Zhou, sp. nov.

KEY WORDS: Plecoptera, Nemouridae, *Nemoura*, new species, China

The genus *Nemoura* is distributed in the Holarctic and Oriental regions. The species of *Nemoura* from China were studied mainly by Wu (1938, 1962, 1973), Zhu and Yang (2003), Li and Yang (2006, 2007) and Wang et al. (2006) with the following 27 known species; *Nemoura securigera* Klapálek, 1907, *N. brevilobata* (Klapálek), 1912, *N. papilla* Okamoto, 1922, *N. nankinensis* Wu, 1926, *N. needhamia* Wu, 1927, *N. geei* Wu, 1929, *N. hangchowensis* Wu, 1929, *N. matangshanensis* Wu, 1935, *N. janeti* Wu, 1938, *N. arlingtoni* Wu, 1939, *N. spinosa* Wu, 1939, *N. yunnanensis* Wu, 1940, *N. manchuriana* Uéno, 1941, *N. cochleocercia* Wu, 1962, *N. furcocauda* Wu, 1973, *N. formosana* Shimizu, 1997, *N. klapperichi* Sivec, 1981, *N. jilinensis* Zhu and Yang, 2003, *N. miaofengshanensis* Zhu and Yang, 2003, *N. basispina* Li and Yang, 2006, *N. floralis* Li and Yang, 2006, *N. guangdongensis* Li and Yang, 2006, *N. perforata* Li and Yang, 2006, *N. sichuanensis* Li and Yang, 2006, *N. oculata* Wang and Du, 2006, *N. atristrigata* Li and Yang, 2007, *N. meniscata* Li and Yang, 2007. This study describes four new species of *Nemoura*: *N. cocaviuscula* Du and Zhou, sp. nov., *N. lui* Du and Zhou, sp. nov., *N. magnispina* Du and Zhou, sp. nov., and *N. rotundprojecta* Du and Zhou, sp. nov. Types of the new species are deposited in the Insect Collection of Yangzhou University, Jiangsu province, China.

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SYSTEMATIC ENTOMOLOGY

Nemoura cocaviuscula Du and Zhou, sp. nov.

Figs. 1-5

Adult Habitus: Antennae dark brown, head and thorax tergum brown, and head slightly wider than pronotum; wing hyaline, brown, veins brown; legs brown.

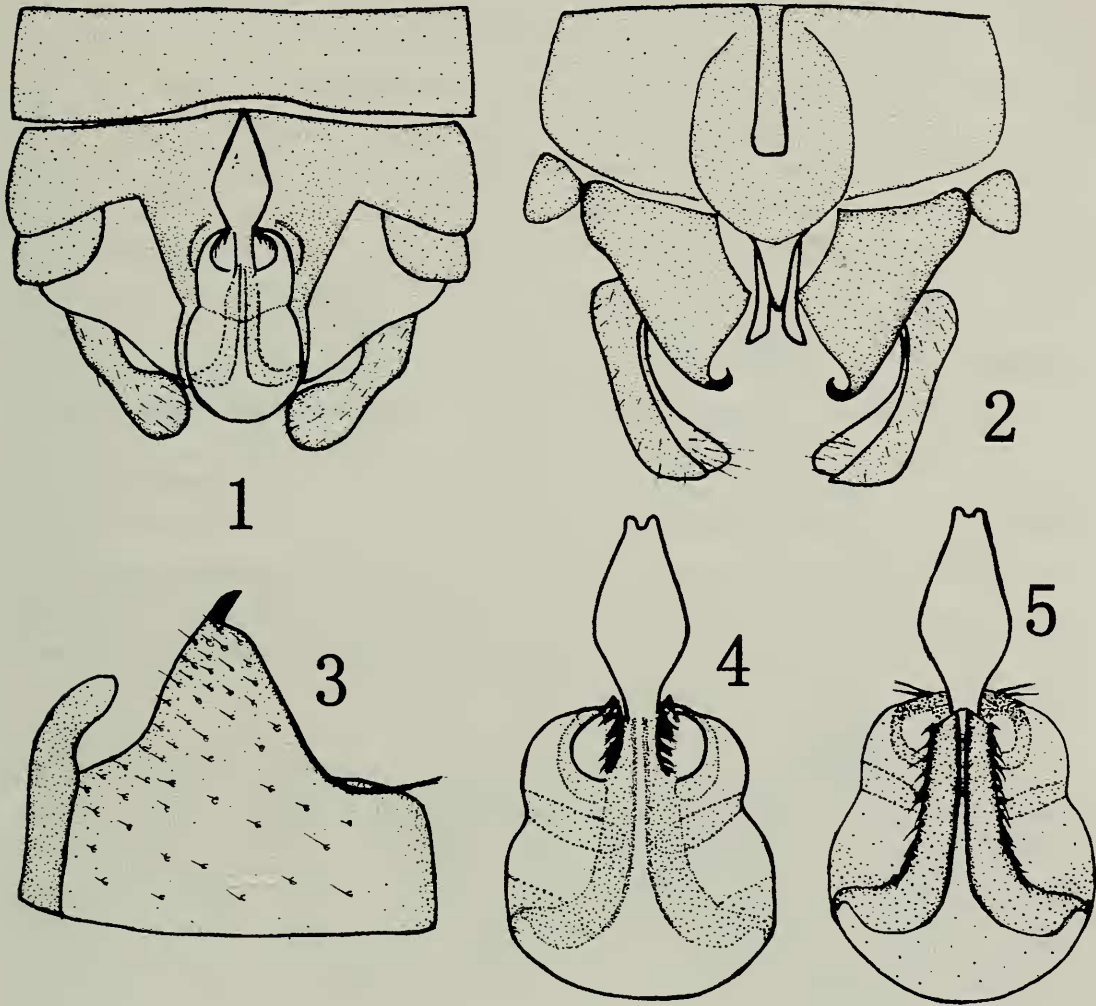
Male: Forewing length 7.3-7.6 mm, hind wing length 6.1-6.3 mm. Abdomen pale at anterior segments and brown at posterior segments. Tergum 9 slightly sclerotized, bearing several slender spines at hind margin; tergum 10 sclerotized and dark brown, forming a large concave area anterior to base of epiproct, which has a small membrane patch in medial; subgenital plate rounded, with a tapering small triangular apex, extending distally but not completely covering inner lobes of paraprocts. The plate gently brown but the hind margin dark brown; vesicle pale and slender but slightly enlarged at base, terminated straight; paraprocts consisting of 2 lobes; inner lobes sclerotized, slender, slightly turned outward at apex; outer lobes sclerotized, broad rectangle at base and extending to a tapering triangle which is terminated by a curved outward, dark sclerotized hook, outside margin forms a dark sclerotized strip surrounding base of cerci, the lobe covered with a few hairs; epiproct calabash-shaped in dorsal aspect, elongated and forming a long white rhombic membranous projection at middle of anterior margin, and at base of the projection, sclerotized prong absent but forming a pair of sclerotized strips which bear a row of spines; dorsal sclerite calabash-shaped, slightly sclerotized, subhyaline and broad, slightly concaved laterally in middle, not bearing spines; ventral sclerite sclerotized, pairs ridges wider than other species in the genus, bearing two rows of spines; cerci outside dark sclerotized, lateral portion forms sclerotized strip, spines or hooks entirely absent end; gently swollen at end and bearing several long hairs.

Female. Unknown.

Type Material: Holotype ♂, Laodian, Tianmu Mountain, Zhejiang Province, 1185m, 10 May 1998, Leg. DU Yu-Zhou. Paratypes, 5 ♂♂, same data as the holotype.

Diagnosis: This new species is similar to *N. geei* in having a long protrusion extending from apex of epiproct, but can be separated from the latter by the calabash-shaped dorsal sclerite and rows of spines on ventral sclerite of epiproct.

Etymology: The name refers to the epiproct slightly concaved laterally in middle part. Latin "*cocaviuscul-*" meaning to be slightly concaved.



Figures 1-5. *Nemoura cocaviuscula* Du and Zhou, sp. nov. 1. Male terminalia, dorsal; 2. Male terminalia, ventral; 3. Male paraproct; 4. Male epiproct, dorsal; 5. Male epiproct, ventral.

Nemoura lui Du and Zhou, sp. nov.

Figs. 6-11

Adult Habitus: Antennae and head dark brown; head slightly wider than pronotum; wing hyaline, brown, veins dark brown; legs brown.

Male: Forewing length 6.0-7.0 mm, hind wing length 5.2-6.1 mm. Tergum 9 sclerotized, but not produced bearing thin hairs and spines, the tergum concaved backward at middle of the anterior margin. Tergum 10 also concaved backward at middle of the anterior margin, the segment mostly sclerotized forming a large concave area anterior to base of epiproct, which is longitudinally membranous in median, is elevated postero-mesally, forming a pair of dark sclerotized arc

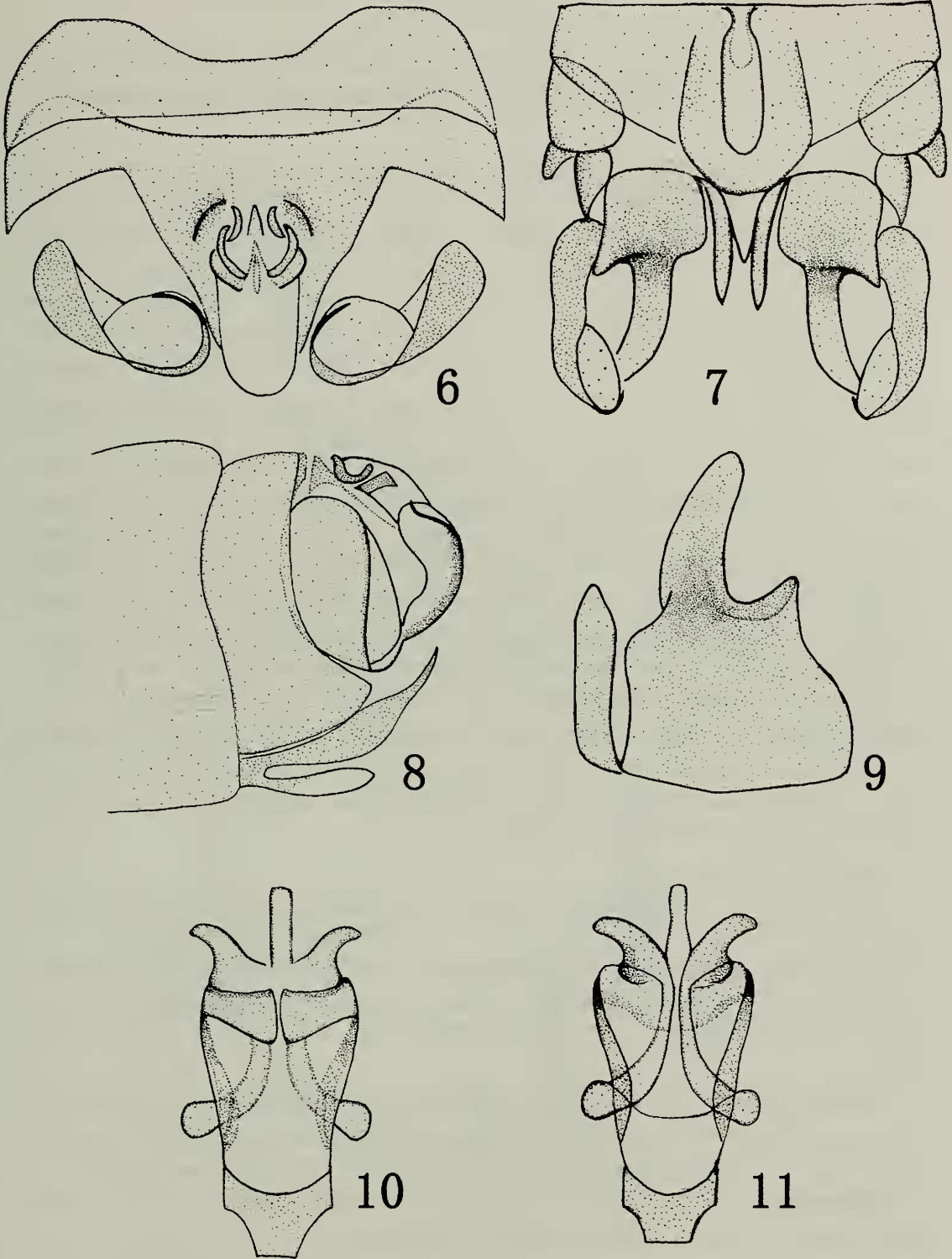
ridges; subgenital plate broad, tapering with a small narrow apex, extending distally to base of paraprocts, not covering inner lobes, sclerotized and the hind margin dark brown, vesicle pale, broad but thin at base; paraprocts consisting of 2 lobes; inner lobes sclerotized, moderate width and length, slightly turned inward, not hidden by hypoproct; outer lobes sclerotized, broad at base and extending postero-mesally to forming a tapering sclerotized bar; epiproct partial sclerotized, bilaterally symmetrical, base narrow and end broad, it elongated antero-mesally and forms a slender membranous finger-shaped projection; on either side base of the projection forming two conical sclerotized projections; dorsal sclerite sclerotized, narrow at base and broad at end, forming a pair of sclerotized rectangle portions at anterior margin, the sclerite not bears spines; basal sclerites is a membranous, hyaline, colorless patches, with sclerotized lateral margin located at base of epiproct; ventral sclerite darkly sclerotized, parallel ridges not bearing spines, extending outward and upward to dorsal surface and forming a pair of projections near the apex which turning outward, not bearing spines or hooks; cerci outside of cerci dark sclerotized, lateral portion forms sclerotized strip and is terminated by a sclerotized hook, spines are entirely absent; membranous inner region swollen at end and bearing small hairs.

Female: Unknown.

Type Material: Holotype ♂, South Tributary of Source of Jialing River, Tiantai Mountain, Qinling Mountain Range, Shaanxi Province, 1800m, 10 Jun. 1998, Leg. DU Yu-Zhou. Paratypes 4 ♂♂, same data as the holotype; 16 ♂♂, East tributary of Source of Jialing River, Tiantai Mountain, Qinling Mountain Range, Shaanxi Province, 1900-2050m, 8 Jun. 1998, Leg DU Yu-Zhou; 3 ♂♂, Huodigou, Huoditang, Qinling Mountain Range, Nigshaan County, 1900m, 5 Jun. 1998, Leg. DU Yu-Zhou.

Diagnosis: This new species appears similar to *N. spinosa* in dorsal view of the epiproct, but can be separated from the latter by the tapering sclerotized bar extending from outer lobes of paraprocts (Fig. 8).

Etymology: The name in honor of Professor Zi-Qiang Lu, for his assistance with our research.



Figures 6-11. *Nemoura lui* Du and Zhou, sp. nov. 6. Male terminalia, dorsal; 7. Male terminalia, ventral; 8. Male terminalia, lateral; 9. Male paraproct; 10. Male epiproct, dorsal; 11. Male epiproct, ventral.

Nemoura magnispina Du and Zhou, sp. nov

Figs. 12-17

Adult Habitus: Antennae dark brown, head and thorax tergum dark brown, and head slightly wider than pronotum; wing hyaline, brown, veins brown. Legs brown.

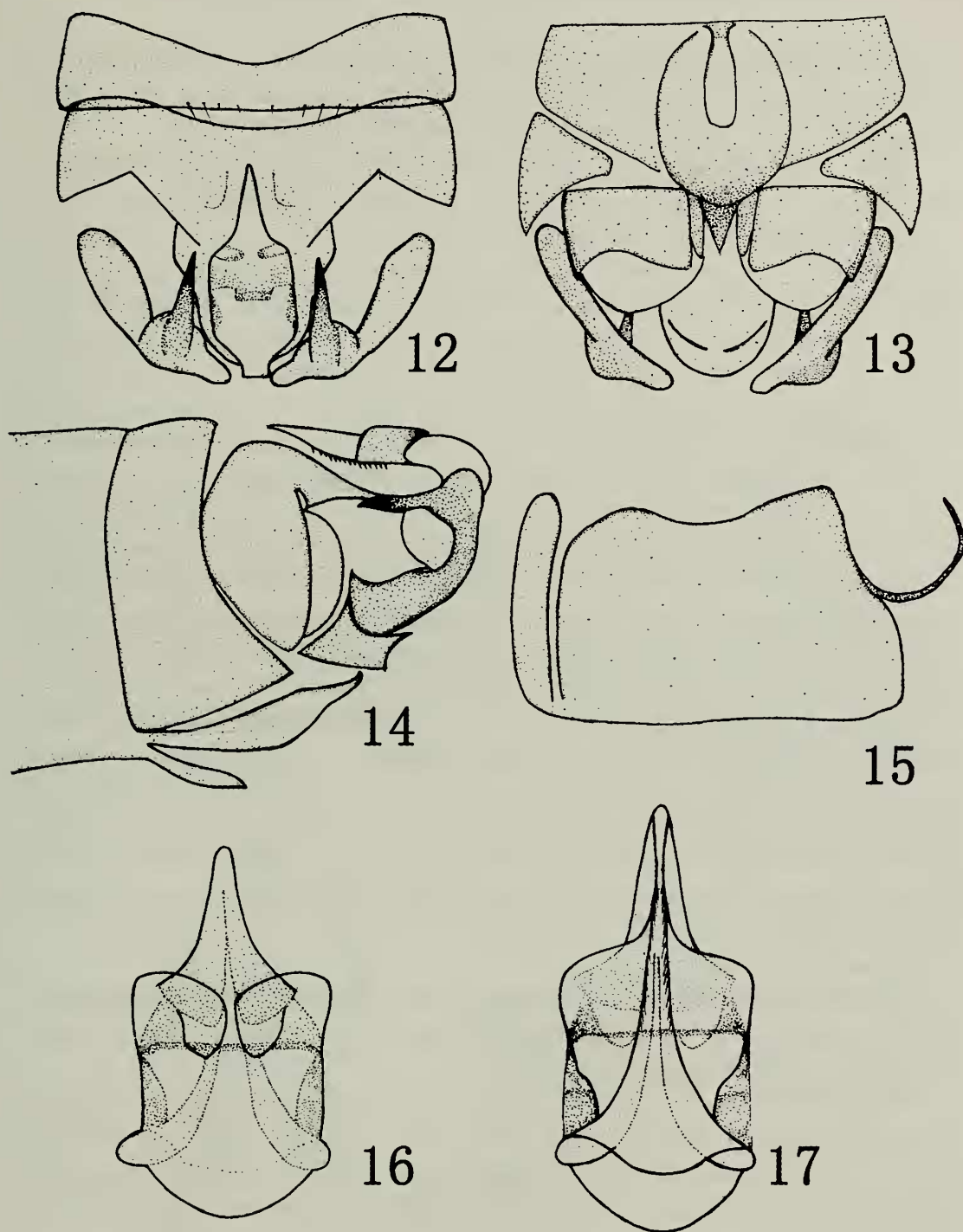
Male: Forewing length 8.2-9.0 mm, hind wing length 7.2-8.0 mm. Pale at anterior segments and brown at posterior segments. Tergum 9 slightly sclerotized, bearing thin hairs at hind margin and concave backwards at middle of anterior margin. Tergum 10 is not concave at middle of the anterior margin but bearing a little of spines and hairs. The segment sclerotized forming a large concave area anterior to base of epiproct, which has a small membrane patch in medial, forming a pair of dark sclerotized hook-shaped ridge at anterior of epiproct. Subgenital plate rounded, and forms a tapering with a small triangular apex, not covering inner lobes of paraproct, the hind margin dark brown; vesicle does not reach half of subgenital plate, it is pale except lateral margin which is brown, broad except at base which is thin. Paraprocts consisting of 2 lobes; inner lobes sclerotized, slender, nearly equally as long as outer lobes; outer lobes sclerotized, broad rectangle and not forming sclerotized bar; outside margin of outer lobe forms a turned outward slender sclerotized strip which around base of cerci. Epiproct sclerotized and elongated antero-mesally forming a long conical membranous projection, but not forming sclerotized projections on either side base of the projection; dorsal sclerite sclerotized, short and broad, not bearing spines; ventral sclerite sclerotized, broad at base and narrow at apex, ridges bearing two rows spines near apex; cerci outside dark sclerotized, extending distally inward and upward, terminated by a large sclerotized spine; membranous inner region swollen at end and bearing small hairs.

Female: Unknown.

Type Material: Holotype ♂, Huodigou, Huoditang, Nigshaan County, Qinling Mountain Range, Shaanxi Province, 1900-1950m, 5 Jun. 1998, Leg. SUN Chang-Hai and YANG Lian-Fang. Paratype 10 ♂♂, same data as the holotype; 2 ♂♂, East tributary of Source of Jialing River, Tiantai mountain, Qinling Mountain Range, Shaanxi Province, 1900-2050m, 8 Jun. 1998, Leg DU Yu-Zhou.

Diagnosis: There are no closely related species among other described *Nemoura* species known from China and adjacent countries. Characteristic shape of cerci (Fig. 14) clearly separates this species from all other *Nemoura* species.

Etymology: The name refers to the cercus forming a large sclerotized spine. Latin "magni-" means large and "spina" means spine.



Figures 12-17. *Nemoura magnispina* Du and Zhou, sp. nov. 12. Male terminalia, dorsal; 13. Male terminalia, ventral; 14. Male terminalia, lateral; 15. Male paraproct; 16. Male epiproct, dorsal; 17. Male epiproct, ventral.

Nemoura rotundprojecta Du and Zhou, sp. nov

Figs. 18-23

Adult Habitus: Antennae light brown, head and thorax tergum brown, and head slightly wider than pronotum; wing subhyaline, fumose, veins dark and distinct; legs light brown, but joints of femur and tibia brown.

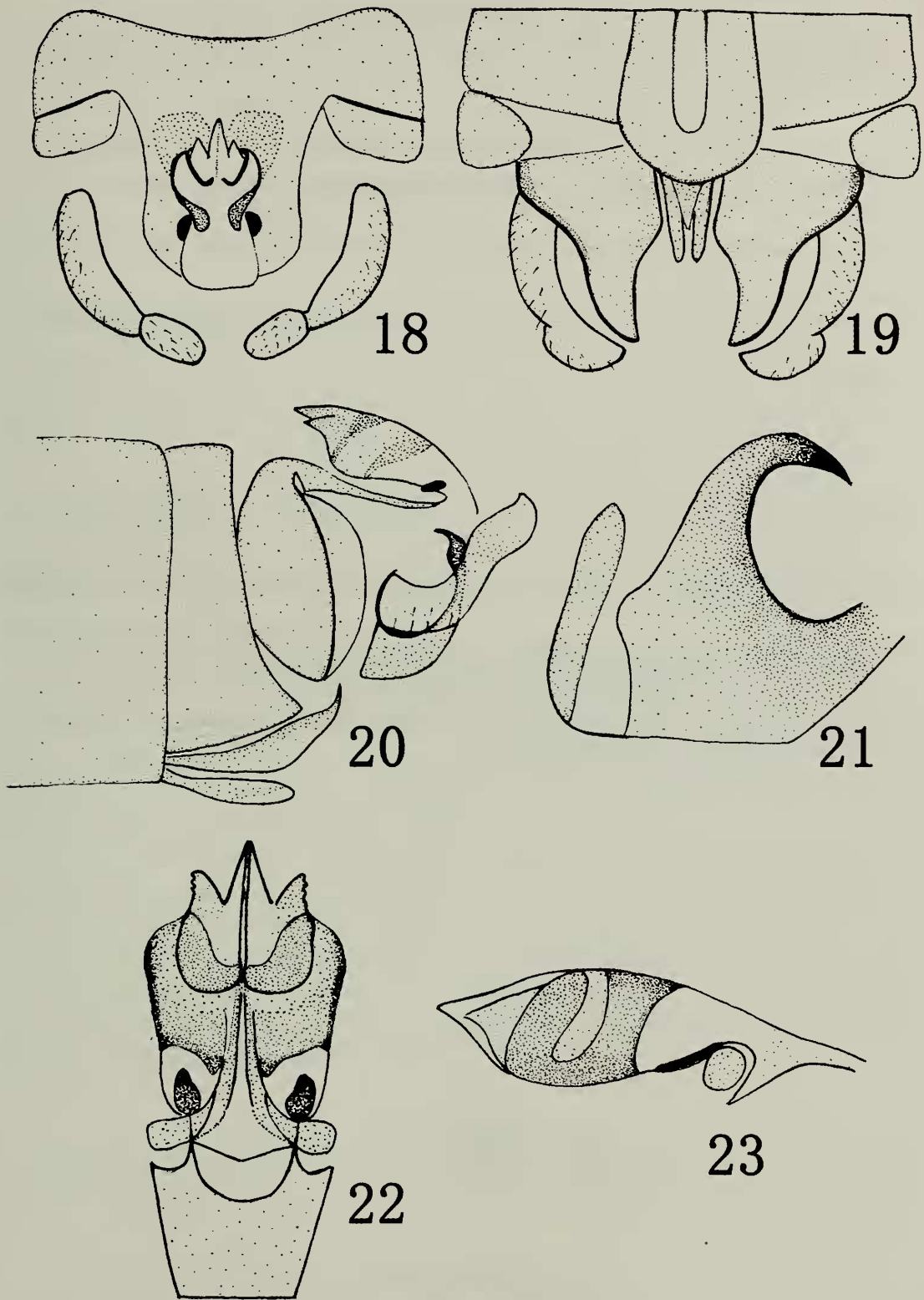
Male: Forewing length 6.5-7.3 mm, hind wing length 5.4-6.0 mm. Tergum 9 membranous, and not produced. Tergum 10 lightly sclerotized, forming a concave area anterior to base of epiproct, bearing a few small spines; the concave area highly sclerotized and dark brown below epiproct forming pair of dark brown patches, except the linear membrane along midline. Subgenital plate broad with rounded hind margin, extending distally to form an acute small triangular tip which is covering a part of inner lobes of paraproct; vesicle is about two-thirds as long as subgenital plate, membranous but sclerotized at base and margin which is brown; paraprocts consisting of 2 lobes; inner lobe sclerotized, narrow and reaching over half of outer lobes, turning inward and incompletely hidden by subgenital plate; outer lobes sclerotized, broad at base then abruptly tapering and forming a hook-shaped apex which turned outward, outside margin is highly sclerotized and dark brown. Epiproct projected antero-mesally, which have longitudinal dark areas in the midline; ventral sclerite forming two conical sclerotized prongs on either side at base of the projection dorsal sclerite short and broad, lightly recurved, sclerotized, bilaterally symmetrical, extending dorsolaterally, dorsal sclerite largely sclerotized; basal sclerites is one broad, trapeziform, slightly sclerotized patch located on base of epiproct; ventral sclerite sclerotized, with black spheriform sclerotized lobes at basolateral corners, parallel ridges not bearing a row of small spines, not bearing spines or hooks; cerci slightly sclerotized on the outside extending inward, lateral portion as sclerotized strip that have no spines or hooks, but have long and thin hairs. Body of cercus elongate and of moderate width with swollen apex.

Female: Unknown.

Type Material: Holotype ♂, Baishui River of Bottom of Snow Mountain of Yulong, Lijiang City, Yunnan Province, 2880m, 9 May 1996, Leg. DU Yu-Zhou. Paratypes 4 ♂♂, same data as the holotype.

Diagnosis: This new species is similar to *N. floralis* in having hook-shaped tip of outer lobes and swollen tip of cerci, but can be separated from the latter species by the dorsal view of the epiproct apex and the two black spheriform sclerotized lobes located on basolateral corners of ventral sclerite of epiproct (Fig. 20).

Etymology: The name refers to the epiproct forming two black spheriform sclerotized lobes at basolateral corners. Latin "rotund" means rounded, spheriform.



Figures 18-23. *Nemoura rotundprojecta* Du and Zhou, sp. nov. 18. Male terminalia, dorsal; 19. Male terminalia, ventral; 20. Male terminalia, lateral; 21. Male paraproct; 22. Male epiproct, dorsal; 23. Male epiproct, lateral.

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LITERATURE CITED

- Baumann, R. W.** 1975. Revision of Stonefly Family Nemouridae (Plecoptera): A Study of the World Fauna at the Generic Level. *Smithsonian Contributions to Zoology* 211: 1-74.
- Li, W. H. and D. Yang.** 2006. New species of *Nemoura* (Plecoptera: Nemouridae) from China. *Zootaxa* 1137: 53-61.
- Li, W. H. and D. Yang.** 2007. Two new species of *Nemoura* (Plecoptera: Nemouridae) from Henan, China. *Zootaxa* 1511: 65-68.
- Shimizu, T.** 1997. The species of the *Nemoura ovocercia* Group (Plecoptera: Nemouridae). *Aquatic Insects* 19 (4): 193-218.
- Wang, Z. J., Y. Z. Du, I. Sivec, and Z. Z. Li.** 2006. Records of some Nemouride species (Order: Plecoptera) from Leigong Mountain, Guizhou Province, China. *Illiesia* 2(7): 50-56.
- Wu, C. F.** 1973. New species of Chinese stoneflies (Order Plecoptera). *Acta Entomologica Sinica* 16(2): 97-118.
- Wu, C. F.** 1938. *Plecopterorum Sinensium: a monograph of stoneflies of China (Order Plecoptera)* Peiping, China. 225 pp.
- Wu, C. F.** 1962. Results of the Zoologico-Botanical expedition to southwest China, 1955-1957 (Plecoptera). *Acta Entomologica Sinica* 11 (Supplement): 139-153.
- Zhu, F. and D. Yang.** 2003. Two new species of *Nemoura* from China (Plecoptera, Nemouridae). *Acta Zootaxonomica Sinica* 28(3): 474-477.